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METHOD FOR IMPROVING QUALITY OF FOOD PRODUCTS CONTAINING PROTEIN

[Tanpakushitsuganyushokuhin no hinshitsu wo kaizensuruhoho]

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Detailed Description of the Invention

The present invention relates to a method for improving quality of food products containing protein.

It is well known that, in order to improve quality of meat and meat products and their retentivity of meat juice, especially when they are heated, a certain chemical compound containing inorganic phosphorous, especially polyphosphate is added to the meat and meat products.

For example, by injecting aqueous solution containing salt and polyphosphate into a meat for ham, not only the color of the ham but also its retentivity of meat juice are improved. With this injection, the ham can favorably preserve the water content containing the meat protein, the aromatic element blended with the water and the meat juice itself during the next processing phase such as cooking or/and smoke-dry phases. A chemical compound containing inorganic phosphorous is also used to make sausages.

In fact, an appropriate amount of chemical compounds containing inorganic phosphorous is mixed into a variety of food products. In these cases, however, the flavors of the products

¹ Numbers in the margin indicate pagination in the foreign text.

may be lost, or there may be other defects, and sometimes crystals are formed in the food products. Examples of these problems include corrosion of tinned metal and hydrolysis of polyphosphoric acid. Also, as one of these problems, the phosphate is dissolved into the saline solution, which is left dissolved. These are the reasons why an excellent additive to obtain the same effects as in the case where polyphosphate is added to meat and meat products is sought.

In addition to the solution injected to ham meat and the cutter auxiliary used for sausage stuffing, the aforementioned additive agent is used for cream cheese manufacturing and salt-water bathing for preserving fishes and vegetables. In almost all cases, the value of an additive agent is determined by the retentivity of meat juice which is increased due to the additive agent used. The best standard to evaluate a variety of additive agents is to use the additive agent as the solution injected to ham meat. In this method, as the standard comparing the retentivity of meat juice, results obtained from the weight increase caused by injecting the solution and possible water retention are shown in percentage of the weight increase on one hand. On the other hand, results obtained from the weight decrease caused by sterilization, disinfection and smoke-dry process of the ham meat are shown in percentage of the weight

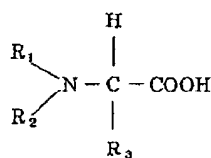
decrease (removed bones or bacon skins do not affect these results). However, the original materials for this type of test are not always uniform and the test results do not have reproducibility. Therefore, it is necessary to evaluate the results by using a great number of ham meat. It is not desirable that a canned ham produces gelatin. That is, canned ham products are often controlled by certain regulations and it is necessary to keep the weight of the gelatin from exceeding a maximum number. Furthermore, the evaluation on the gelatin-forming property requires a significantly great number of expensive tests combining different storing periods with the standard condition. According to the present invention developed by the inventor, the method to conduct the present invention is simple, and by this method, it is possible to obtain results meeting the practicality and completely comparable to each other.

According to the present invention, it is found that excellent results are obtained when a food product containing protein is made in contact with monobasic amino acid containing an additive agent with a pH value of at least about 6.

As the amino acid, it is possible to use L-shaped and D-shaped amino acid or a racemic compound. Especially, it is possible to use α -amino acid. It is well known that the I part

of α -amino acid is in free state and, as a structural unit for animal and vegetable protein, a great variety of α -amino acid exist in the natural world. /2

A general formula of these amino acid is represented by the following formula (In the formula, R_1 , R_2 and R_3 represent hydrogen, substituted hydrocarbon residue and non-substituted hydrocarbon residue respectively. Sometimes, they have primary amino group, secondary amino group and third-degree amino group):



This amino group may form a part of a cyclic structure such as histidine, proline, oxyproline and tryptophan. A cyclic structure comprised of hydrocarbon alone is found in phenylalanine, tryptophan and tyrosine.

It is preferable that food for humans should exist in the natural world without changing their forms. Alternatively, it is preferable to use these amino acids which form structural elements of animal and vegetable protein. The chemically-pure amino acid group containing synthetic compounds and amino acid compounds produce excellent results. An appropriate amino acid

compound can be obtained by hydrolizing gelatin, casein, fibrin, serum albumin, hemoglobin, zein and keratin with hydrochloric acid or phosphoric acid, or by decomposing them with protease (pepsin, trypsin, papain and pancreas extract), or by alkali-hydrolizing them, in which an amino acid salt compound can be directly obtained.

The amino acid salt used as the additive agent in the present invention can be conveniently manufactured in a dried form, and can be mixed with its salt group if needed to be used for a variety of purposes. The dried product can be rubbed over the surface of an original meat, or it can be mixed with one or more types of materials such as salt, condiments and/or aromatic elements and then rubbed over the surface of the meat. When the penetration of the mixture into the meat is accelerated by creating holes in the surface with devices such as a fork, the effect of making the surface smooth is significant. This effect can be further increased by spraying water to the surface of the meat or brushing the surface before or after the mixture is rubbed over the surface.

When the amino acid salt is used in a dried form, it is convenient to make small particles. The effect of making the surface smooth is greater and faster when the powder-form amino acid salt is used as the cutter auxiliary. Furthermore, the

speed of dissolving the amino acid salt in a water solution is increased. It is preferable to use the amino acid salt with about 100 micron or smaller particles.

Moreover, as an advantage of using amino acid and the mixture of amino acid and salt, they can quickly dissolve into salt water and do not settle out of the solution and do not produce residues which are the case with known additive agents containing phosphorous. Furthermore, the amino acid and the mixture of amino acid and salt do not corrode containers coated with tin, in order to prevent the tinned parts where ham is placed from blackening and being contaminated, special treatments such as coating with varnish are not needed. It is preferable to choose a compound having alkali medium and a high solubility as is the case with amino acid groups. The effects of an amino acid group where amino group is separated from a carboxyl group such as a β -amino acid group or a τ -amino acid group are greater, but an α -amino acid group is even more convenient because it does not produce harmful side effects.

In manufacturing sausages, as a result of using the product obtained by the present invention, when especially 0.3 - 1 % of the dried product to the whole stuffing is added to the cutter auxiliary, the protein, fat and water content of the meat

are bound tightly, and consequently, a hard and uniform sausage is obtained.

Especially when a great amount of amino acid group are added, it is preferable to pay attention to the amount of the chemical compound forming a complex compound with calcium and/or magnesium which exist in protein. Examples of these chemical compound include: alkali citric acid, tartaric acid, lactate, nitrilotri-acetate, ethylenediamine-4 acetate or polyphosphate. A certain amino acid, especially glycine, easily forms a complex compound with Ca ion and Mg ion. This also proves that it is better to add the aforementioned compound.

Other known additive agents such as ascorbic acid, sodium ascorbate group, nitric acid group and sodium nitrite group can also be added to the mixture of amino acid and salt.

As the salt from amino acid groups, potassium salt, sodium salt or ammonium salt can be used. Salt from alkaline earth compounds or chemical compounds obtained from other compounds can be used. However, the pH value of the 1 % water solution of the mixture should be kept to at least about 6 or more.

Making the aforementioned salt beforehand is not always necessary. The salt can be formed when the product is dissolved.

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As the cutter auxiliary, the salt groups or salt-contained mixtures and free acid are optimum for the original material.

Strongly-basic mild acid salt or monobasic mild acid salt or mild acid salt with more than one base including sodium carbonate, sodium carboxylate and sodium hydrogenphosphate can be used for the aforementioned purposes. The compounds made by mixing the above-described compounds or the mixture with alkali hydroxide can be also used. Calcium salt and magnesium salt of amino acid can obtain preferable effects even though these effects are not as good as those of alkali salt.

The neutral salt and basic salt of the amino acid, and the alkali salt and acid salt (HCl) can also be used. Alkaline and alkaline earth salt can also be used. When it is possible to improve the distribution within a protein-containing food product as is the case with the injection of multiple needles in the ham meat, the effects of these additive agents are excellent even with a pH value of 10 or more, or even 12 or more. This is because the quality of the food product will be deteriorated rapidly if the distribution is not improved. Furthermore, it is a phenomenon that a mixture containing amino acid with the pH value of about 8-10 can significantly improve the color tone of meat treated with a salt water solution. It is preferable not to

exceed a pH value of 10 since an extremely high pH value can cause technical obstacles in implementing the test.

Instead of using a free amino acid which is mixed with alkaline substances such as alkali hydroxide, alkali carbonate or other slightly-acidic alkali salt, amino acid salt is preferably used. In this case, amino acid salt can be mixed with free amino acid, the acidic element or the alkali element in order to obtain a desirable pH value.

Compared with commonly-used additive agents, in addition to the excellent retentivity of meat juice, the additive agent of the present invention can provide the meat product with a good aromatic property as another advantage when the meat product is cooked or fried with oil.

The additive agent of the present invention can be used at room temperature, at 0 °C, or at 0 °C or lower. The additive agent can be used at a high temperature if needed. This is because amino acids are extremely stable against changes in temperature. Also, the additive agent does not have any problems with being used under decreased or increased pressure. Especially when the ham meat is treated with the "multi-needle" injection of the additive agent, there is no chance that the needle can be clogged up, because the additive agent is easily dissolved into salt water solution.

When amino acid has a sufficiently high pH value on its own, it is possible to decrease the pH value by adding some acidic element. In this case, salt groups having acidic reactions, organic acid groups and acidic salt can be used in addition to acetic acid. Examples of these include: sodium dihydrogenphosphate, acidic sodium sulfate, citric acid, lactic acid, tartaric acid and nitric acid. As the salt groups having acidic reactions, chemical compounds such as mono-acetate from lysine can be used.

The amino acid chemical compound used in the present invention is especially important in treating meat and meat products such as ham, sausages and other products.

When the additive agent is unevenly distributed in the meat and meat products, the buffering action of the amino acid chemical compound of the present invention at the range of pH values of 5.5 to 8 is especially useful. When the additive agent is injected into ham meat, the treatment can be done locally, that is, the additive agent can be subcutaneously injected into the veins. Alternatively, the additive agent can be more evenly distributed in the meat product, that is, the additive agent can be added to the meat product by using a multiple-needle injection. The first method is used to obtain results which can be accepted by the best buffering action of

the additive agent at a low pH value, that is, the range of pH values of 5.5 to 7.5. This method is used because, if the method is not used, many gelatin-like spots are formed locally in the meat which can be no longer used. When the additive agent is more evenly distributed in the meat, the result can be little influenced by the buffering action. However, when the additive agent with a good buffering action is injected, it is possible to obtain a finished meat product with better quality. Obviously, the additive agent with the buffering action having a pH value of 5.5 or lower is not important. Generally, it is preferable to use the additive agent with the lowest pH value as is possible and prevent local defects of the meat product or decomposition caused by bacteria, which are the result of the pH values higher than the desirable level.

Glycine, lysine and a variety of other monobasic amino acid groups can product chemical compounds with favorable buffering actions when their pH value is 6 or more, which can be made by adding alkali to these amino acid groups, or adding acid when the pH value is higher than the desirable level. Bi-basic amino acid groups such as glutamic acid do not have the buffering action at the range of pH values needed for the present invention, therefore, they do not have practical values for the purposes of the present invention.

The buffering action is preferably made at a range of pH values 5.5 to 8. From this perspective, histidine is the most significant element among the chemical compounds used for the present invention.

When the additive agent is injected to the meat as water solution, the lowest limit of the additive agent depends on the desired effects. Generally, it is necessary to add at least 0.05 % of amino acid to the weight of the food product. When the additive agent is used as a dried mixture and sprayed over the surface of the meat, the lowest critical pH value cannot be determined because it depends on factors such as the types of meat processed, the surface of the meat and the water content of the meat which depends on the surface temperature. /4

The highest limit of the pH value influences the flavor of the meat in many cases. Many amino acid groups have a uniform, or sometimes impressive flavor when they are added in large quantity. Glycine produces a sweet flavor. However, when about 0.75 % or more of glycine to the weight of the ham meat is added, glycine produces an unpleasant flavor. A greater or smaller amount of other amino acid groups can be used, although their amounts do not usually exceed 2 % by weight of the meat product. When the amino acid groups are used to immerse the meat product into their water solution, other elements including sodium

chloride, nitrite salt, nitrate salt, carbohydrate or other known chemical compounds are added to the aforementioned amino acid groups. As a result, 0.5 - 10 % of amino acid solution can be used.

Next, the present invention will be described using the Embodiments below:

Embodiment 1

Determination of the water bonding characteristic (WBC) of the meat.

Fat is removed from 1 kg of beef as much as possible, and the defatted meat is thinly cut twice by using a mincer having a 4 mm plate. Then, the meat is placed into a cooling space for 16 hours at 1 - 4°C. After that, the meat is thinly cut by the 4 mm plate of the mincer once more.

100 g of this meat is scaled and placed into a 1000 ml beaker, and 300 g of water with the water temperature of 1 - 4°C is added to the meat. Then, 8 g of NaCl is added to this mixture.

A chemical compound on trial is added to the mixture. Then, the mixture is homogenized at 10000 rpm for 2 minutes.

100 g of the homogenized mixture is filled into 3 centrifuge tubes respectively, and placed in water at 65 °C for

1 hour. Then, the centrifuge tubes with the mixture are placed in water at 10 - 15°C for 5 minutes. Immediately after that, the tubes are centrifuged at 2800 rpm for 15 minutes. Then, the water is removed from the mixture to separate the water and the meat. The centrifuge tubes where the meat having the bonding water are scaled and at the same time the removed water is also scaled. When the weight of the sum of the weight of the meat and the weight of the water is represented by R and the weight of the chemical compound on trial as the dried form is represented by D, WBC, that is, the amount of the water contained with the 100 g of meat is expressed with the following formula:

$$WBC = 0.01(408 + D)R - (108 + D)$$

It is necessary to conduct each test for 10 - 12 times in order to obtain reliable data.

In order to eliminate fluctuation of the meat product, the chemical compounds on trial are always divided in two portions. A selected standard material is added to one of the two portions and an additive agent on trial is added to the other portion. It is found that $\text{Na}_4\text{P}_2\text{O}_7$ is effective as the standard material. The following formula shows the ratio:

$$\frac{\text{WBC additive agent on trial}}{\text{WBC Na}_4\text{P}_2\text{O}_7} = P \pm Q\%$$

With this method, fluctuation of the meat product is eliminated.

When the WBC of a unprocessed meat is compared with the $\text{Na}_4\text{P}_2\text{O}_7$, the following value is obtained:

$$\frac{\text{WBC an unprocessed meat}}{\text{WBC}(\text{Na}_4\text{P}_2\text{O}_7)} = 0.19 \pm 0.02$$

In this case, the pH value of the meat is 5.8. This is determined in the method described below.

3000 cc of water is added to 100 g of meat, and the resultant mixture is mixed by using a wearing mixing machine for 5 minutes.

Then, the pH value of the meat is determined by a glass calomel electrode.

In order to minimize the salt error, it is necessary to increase the dilution. The salt error is significantly large in the meat product processed with phosphorous. This is because

the pH value becomes lower than the desired level when using the slurry which is not diluted.

Embodiment 2

A standard mixture is composed from 47 % of lysine, 20.1 % of sodium lysinate and 32.9 % of salt.

This mixture is added to lean beef, and the ratio of the water bonding characteristic is compared to that of $\text{Na}_4\text{P}_2\text{O}_7$ by using the method described in Embodiment 1. 2 g of $\text{Na}_4\text{P}_2\text{O}_7$ is used for each of 100 g of meat. The results are shown in the following table:

The amount of lysine standard mixture added to the meat	$\frac{\text{WBC}}{\text{WBC}}$	$\frac{\text{additive}}{\text{Na}_4\text{P}_2\text{O}_7}$	$\frac{\text{agent}}{\text{agent}}$
2.0 g		1.29 ± 0.14	
1.7 g		1.15 ± 0.12	
1.6 g		1.00 ± 0.10	
1.5 g		0.89 ± 0.09	

When 50 g of citric acid is added to 100 g of lysine standard mixture, the quotient of WBC increases about 0.2 by unit.

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When 1 g of ethylenediamine-4 carboxylic acid is added to 1.6 g of lysine standard mixture, the quotient of WBC increases from 1.00 to 1.15 by unit.

Embodiment 3

300 ml of water, 8 g of NaCl and 2 g of different types of amino acid groups are added to 100 g of meat. A part of the amino acid groups is always converted to sodium salt so that the pH value of 1 % water solution becomes 9.6. With respect to the function of $\text{Na}_4\text{P}_2\text{O}_7$, all of the amino acid groups increase the water bonding characteristic compared with meat without any additive agents. However, under a test condition, for example, when the 1 % solution is used at the pH value of 9.6, some amino acid groups such as glycine bonds with the solution less frequently than the case of sodium pyrophosphate.

amino acid groups	$\frac{\text{WBC}}{\text{WBC}} \frac{\text{additive}}{\text{Na}_4\text{P}_2\text{O}_7} \frac{\text{agent}}{\text{agent}}$	
	when t'-salt is used	
glycine	0.81	0.86
arginine	1.11	1.09
cystine	1.30	1.21
lysine	1.44	1.48

The result of using potassium salt of amino acid groups is the same as the case where sodium salt is used within the test error range.

Embodiment 4

A standard mixture composed of 58 % of Na-glysinate and 42 % of NaCl (the pH value of 1 % water solution is 10.6) is added to the meat by changing the amount. By evaluating the results according to the method described in embodiment 1, the influence of the amount of the amino acid groups, which are added to the meat, on the final results are determined.

The results are as follows:

Amount of the amino acid groups added per 1000 g of lean beef (g)	WBC value compared to 2 g of Na ₄ P ₂ O ₇ / 100 g of lean beef
5.0	1.19 ± 0.11
4.2	1.11 ± 0.10
4.0	0.98 ± 0.10
3.0	0.88 ± 0.10

Embodiment 5

A solution mixture made of 35 % of lysine, 35 % of sodium lysinate, 20 % of NaCl and 10 % of sodium citric acid-2hydrate is injected into 14 pieces of ham meat so that 5 g of this mixture is injected as dried form into each 1 kg of the ham meat.

This dried mixture is dissolved into a solution with a liquid measure of about 20 % of the weight of the pre-boned ham meat, and then injected into the ham meat. After that, the ham meat is immersed in salt water for preservation by a commonly-used method for 3 days. Then, the bones are removed from the meat, the boned meat is cooked, cooled and smoked. The weight of the meat is measured at each phase, and the percentages of the injected solution bonded with the ham meat are determined. The results are as follows:

Number	weight of the whole ham meat (g)	net weight of the meat before it is cooked (g)	weight of the meat after it is smoked/cooled for 36 hours (g)	weight of the solution injected to the meat (g)	water content bonded with the meat (%)
25	4830	4760	4250	1120	52.8
26	5270	4930	4350	990	37.6
27	5000	4830	4250	1050	42.6
28	5000	4850	4350	1020	49.2
29	5140	5050	4450	1160	45.7
30	5380	5185	4649	1100	48.7
31	4940	4700	4200	1090	49.8
33	5190	5200	4613	1120	45.1
34	5180	4950	4250	950	23.1
35	5110	5060	4650	1100	61.7
36	5250	5185	4500	1130	36.3
37	5340	5200	4680	1160	52.1
38	5130	4890	4300	1080	42.7
39	5230	5230	4683	1150	50.1

From the numbers in this table, it is obvious that the bonding of the solution significantly increases. Furthermore,

from this table, it is found that changes in the bonding water are caused by the types of the original materials. The tested ham meat has an excellent exterior appearance having a hard structure, and the meat does not have a metal-like flavor, which happens frequently with the ham meat injected with phosphoric acid mixture.

Embodiment 6

The following mixtures are added to 100 g of beef:

Mixture A:	lysine-HCl ... 12.8 %
	lysine ... 50.8 %
	citric acid-2hydrate ... 15.9 %
	NaCl ... 20.5 %
Mixture B:	glycine ... 34.4 %
	sodium glycinate ... 65.6 %
Mixture C:	glycine ... 65.5 %
	sodium glycinate ... 34.5 %

The water bonding characteristics of these mixtures and the beef are compared to the water bonding characteristic of the beef where 2 g of triphosphosphate is added to each 100 g of beef. When the following amounts are added to the beef, that is:

2.0 g of Mixture A;
1.4 g of Mixture B; and
2.2 g of Mixture C,

it is found that the same effects as triphosphosphate can be obtained.

However, according to the sampler of the test, the flavor of the meat product treated with Mixtures A, B and C is always better than the one treated with polyphosphate.

Embodiment 7

By using the method described in embodiment 6, 12 - 15 % of a solution comprised of 12.8 % of lysine-HCl, 50.8 % of lysine, 20.5 % of NaCl, 15.9 % of sodium acid citrate-2hydrate is injected into about 30 pieces of ham meat.

After the bones and fat are removed from the meat by a commonly-used method, the ham meat is packed in a can and cooked. The canned ham is stored at 20 °C. 3 months after that, the crystals are eliminated.

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There is no ham having 7.5 % or more of gelatins. The can is not coated with varnish, and instead it is coated with a good-quality tin. Despite this tin-coating, the inner surface of the can is not damaged showing little signs of corrosion.

Embodiment 8

In Mixture A of embodiment 6, 10 g of EDTA is added to 63.6 g of the lysine and lysine-HCl in place of 15.9 % of citric acid-2hydrate. In this case, 1.7 g of Mixture A has the same result as that of 2 g of triphosphosphate.

Embodiment 9

4 different types of stuffing are composed as follows:

stuffing Number	beef (%)	fat (%)	meat/fat ratio
1	65.0	13.7	4.7:1
2	55.7	25.0	2.2:1
3	52.0	30.0	1.7:1
4	50.7	35.0	1.4:1

1.8 % of salt, 0.5 % of condiments and 0.012 % of NaNO_2 are added to these stuffing. The resultant mixtures are minced in a cutter by a commonly-used method. While the mixtures are minced, an appropriate amount of ice water is added and at the same time a mixture of sodium glycinate, glycine and sodium acid citrate is added so that 3 g of these mixtures are contained in each 1 kg of sausage meat. Among the elements mixed to the mixtures,

52.5 % is glycine, 34.5 % is sodium glysinate, 13 % is citric acid-2hydrate.

The obtained liquid emulsion is stuffed into a sausage roll and dried at 55 °C for one hour. Then, it is smoke-dried at the same temperature, and after that, it is "cooked" at 78 °C for 75 minutes. The results are shown below:

stuffing Number	fat separation rate (%)	gelatin formation rate (%)
1	0.15	2.3
2	1.9	2.9
3	3.8	2.1
4	6.4	1.8

With a sausage meat having the same composition as the above, except the condition that 3 g of sodium triphosphate is added to each 1 kg of the dried sausage meat, the following results are obtained:

stuffing Number	fat separation rate (%)	gelatin formation rate (%)
1	0.18	2.5
2	1.6	2.8
3	4.3	1.6
4	6.1	2.0

From the above-shown results, it is found that a perfect and faultless additive agent for sausage meat by amino acid groups.

Embodiment 10

By using a multiple needle device, solution A is injected into 200 pieces of ham meat, each of which weighs about 5 kg, and solution B is injected into another 200 pieces of ham meat, each of which has the same average weights. The results will be described below:

A:

water ... 1000 kg

salt mixture for hardening the meat comprising 90 % of salt, 6% of nitrite salt and 4 % of nitrate salt ... 110 kg

monosodium glutamate ... 1 kg

mixture comprising 50 % by weight of sodium glycinate and 50 % by weight of glycine ... 23 kg

B:

water ... 1000 kg

mixture comprising 90 % of salt, 6% of nitrite salt and 4 % of nitrate salt ... 110 kg

monosodium glutamate ... 1 kg
mixture comprising 75 % by weight of sodium
tripolyphosphate, 15 % of hyaline high polymer phosphate and
10 % of sodium acid pyrophosphate ... 23 kg

The pH value of 1 % of water solution of the glycinate
mixture and phosphate mixture shows 9.6. The injected amounts
of the glycinate mixture and phosphate mixture are 5 g per 1 kg
of meat respectively.

After the mixtures are injected, the meat is placed in a
salt water solution over night, and then, mixtures A and B are
injected into the meat once again, the meat is packed in a can
and pasteurized until the temperature inside the meat reaches 72
°C. After the can is cooled down, it is opened and the gelatin
in the ham is scaled. The results are as follows:

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treatment	amount of the solution remaining in the ham meat after the solution is injected twice	gelatin generation as a percentage of meat weight (%)	color	flavor	structure
solution A	76.3	4.2	very good	very good	excellent
solution B	74.6	5.0	very good	very good	very good

5 samplers evaluate this ham. The liquid kept inside the ham tightly bonds itself with the ham. The ham has solid and homogeneous viscosity and can be easily cut without falling. This test wherein a great amount of the liquid is not injected, which is usually required, clearly shows that the water bonding characteristic of the amino acid groups of the present invention is better than that of phosphate used to prevent ham and similar meat pieces from drying up and becoming solidified. Especially, as the safe and effective food product and from the excellent industrial perspective, these amino acid groups which are the structural units of animal protein are appropriate.

Embodiment 11

A mixture comprising 75 % of Edam cheese and 25 % of Gouda cheese are crushed to 100 meshes or smaller pieces. A buffer solution containing 15 % by weight of a mixture comprising lysine and lysine-HCl by the ratio of 90 to 10 is added to the above-described cheese mixture by the weight ratio of 20 to 100. The resultant cheese mixture is melted away at 80 °C and cooled down. As a result, a homogeneous cheese which can be easily cut is obtained. By adding a solution containing 15 % by weight of histidine to the cheese by the same weight ratio of 20 to 100, it is possible to obtain an even better result, that is, a smoother cheese.

Embodiment 12

50 pieces of 500 g of cods are immersed into 10 % of histidine solution having a pH value of 7.5 for 2 minutes respectively. Another 50 pieces of cods with the same weights are used as the comparison. These cods are cooled at -15 °C for one month and stored.

Next, while the cods are stored in a refrigerator, the temperature is gradually increased to the freezing point (0 °C).

The dripping water from the cods treated with amino acid is 3.0 ± 0.9 %, whereas the dripping water from the untreated cods

in comparison is 8 ± 1.9 %. Furthermore, the cods treated with histidine have hard structures.

Embodiment 13

By using the same method as embodiment 10, four different types of injection solution A, B, C and D are compared to solution E:

solution	hardening salt mixture (%)	amino acid (%)	amino acid used	pH value of the solution
A	20	10	lysine	8
B	20	10	histidine	8
C	20	10	1-phenyl- alanine	8
D	20	10	methionine	8
E	20	-	-	8

Hydrochloric acid or sodium hydrate is added to all of these solution if necessary so that the pH value is 8.

25 pieces of about 5000 g of ham meat are used for each test and the injection is done with a multiple needle device.

The amount of the solution injected to the ham meat is 10 % by weight of the ham meat and the meat is processed by using the same method as embodiment 10.

The obtained ham has a smooth structure with excellent properties.

According to the evaluation made by 7 samplers, solutions B, C, A and D are put in order of excellent property, and E is put as the significantly lowest.

In solutions A, B, C and D, about 80 % of the whole amount of the solution injected into the ham remain within the ham, while in solution E 26 % remain. The color tones and structures of solution A, B, C and D are very good and excellent and the ham with these solutions have no clots. Furthermore, when the ham is cut, the meat pieces do not fall apart. With solution E, the ham has some glaze with the moisturized surface and color and the structure is fair or good. /9

The rate of gelatin generation of solutions A, B, C, D and E are 2.23, 1.68, 2.39, 3.73 and 7.97 respectively.

Embodiment 14

In the first place, a solution comprising 20 % of hardening salt with the same composition as that of embodiment 10, and 3 % of glycine is injected into 1000 g of beef by the multiple

needle device; in the second place, a solution comprising the 20 % of hardening salt, 3 % glycine and 1 % lysine is injected into the same beef in the same manner; in the third place, a solution comprising the 20 % of hardening salt and 3 % of lysine is injected into the meat in the same manner; and in the fourth place, a solution with the salt is injected into the meat in the same manner as a comparative sample.

The pH values of all the solution except the fourth one are adjusted to 9.

The amount of the solution injected to the meat is set as 20 + 0.5 g per 1000 g of meat.

All of the solution show excellent results. However, it is surprising that, while the seven samplers consider the flavor of the beef injected with pure glycine as good without exception and consider the flavor of the beef injected with pure lysine as different from the comparative sample, they cannot find any difference between the beef injected with the mixture of glycine and lysine and the comparative sample.

Embodiment 15

The fact that the additive agent of the present invention can be used at a relatively low pH value is a significant advantage. Therefore, a standard processing method is

established and 1 % water solution containing 1 g of amino acid is titrated with 0.1 n solution of hydrochloric acid. In order to compare the results, the amount of hydrochloric acid (ml) needed to decrease the pH value from 7.5 to 5.5 and from 9.5 to 5.5 respectively are determined. The results are shown in the following table:

Buffering Property of Amino Acid Solution

amino acid groups	the amount needed to decrease the pH value from 7.5 to 5.5 (ml)	the amount needed to decrease the pH value from 9.5 to 5.5 (ml)
glycine	4	37
lysine	4	39
histidine	56	72
methionine	3	52
cystine	11	75
hydrolytic gelatin A	7	44
hydrolytic gelatin B	6	38

Histidine, which has the best buffering property when being used for ham and sausages, produces a better result than other amino acid groups. Therefore, histidine can be used for the pH value range of 7.5 to 5.5 and, with less frequency, histidine can be used for the pH value range of 9.5 to 5.5.

Gelatin A is obtained by hydrolyzing 10 kg of commercially-sold gelatin in 100 kg of the back-flowing 25 % HCl for one hour. Gelatin B is obtained by the same method described above, where the same amount of gelatin is used but the gelatin is hydrolyzed under reflux for 4 hours. In each case, the hydrolyzed products are treated with activated carbon to remove impure substances.

Both of the products have highly satisfactory properties.

What is Claimed is:

1. Method for improving quality of a food product containing protein, wherein solid-state basic amino acid or amino acid salt is added to a food product containing animal protein including meat and meat products to process the same.